MMIC Power Amplifiers as Local Oscillator Drivers for FIRST

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The Heterodyne Instrument (HIFI) for the Far-Infrared and Sub-millimeter Telescope (FIRST) requires local oscillators well into the terahertz frequency range. The mechanism to realize the local oscillators will involve synthesizers, active multiplier chains (AMC's) with output frequencies from 71-112.5 GHz, power amplifiers to amplify the AMC signals, and chains of Schottky diode multipliers to achieve terahertz frequencies. We will present the latest state-of-the-art results on 70-115 GHz power amplifier technology.

A combination of MMIC driver amplifiers and high power chips designed at the Jet Propulsion Laboratory, TRW, and the University of Massachusetts, were fabricated by TRW using a 0.1 μm 2 mil GaAs pseudomorphic HEMT process [1]. The chips were then diced, and packaged in single chip, cascadable modules designed for the WR10 waveguide band.

We report on power amplifier results which are particularly significant for the needs of FIRST. Foremost, a chain of two driver amps cascaded with a high power chip produced >100 mW from 70-83 GHz (~17% bandwidth!), and over 300 mW between 75-80 GHz [Figure1]. The peak output power for this chain occurred at 79 GHz, with 400 mW of output power. The high power between 79 and 80 GHz is particularly significant for the 1.9 THz (79 x 2 x 2 x 3 x 2) line of CII, to be observed with HIFI. Other significant results include a record power-bandwidth of greater than 100 mW from 89-105 GHz, and better than 100 mW from 100-114 GHz [Figure 2, 3]. A few selected spectral lines of interest to FIRST, along with their frequencies, required power amplifier band, and current state-of-the-art power amp results, are shown in Table 1. Typical power-added efficiencies for an amplifier chain are in the range of 5%-12%, with DC input power levels of 2.5-3.5 Watts.

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[1] P. Huang *et al*, "A 94 GHz 0.35-W Power Amplifier Module," IEEE Trans. Microwave Theory and Tech, 45(12) p.2418.

Spectral Line	Frequency [THz]	Power Amp Frequency Required [GHz]	Pout[mW]
NII	1.461	91-92	200-230
CII	1.900	79-80	340-400
NII	2.459	102-103	100-150
HD	2.674	111-112	160-190

Table 1.

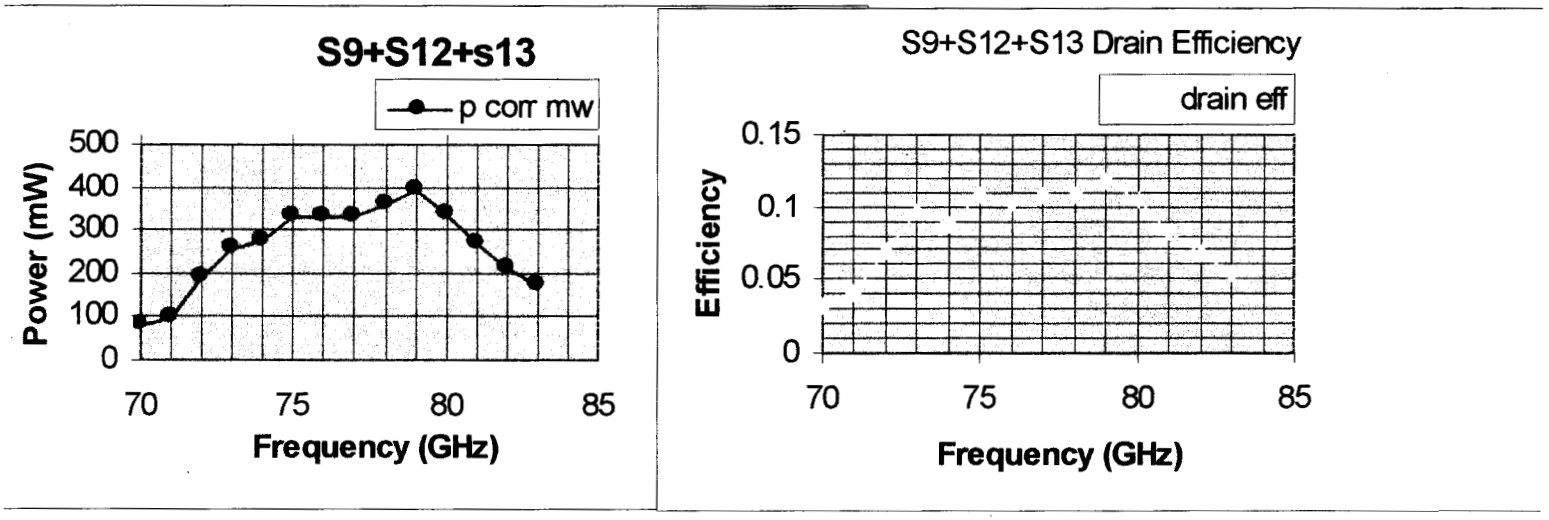

Figure 1.

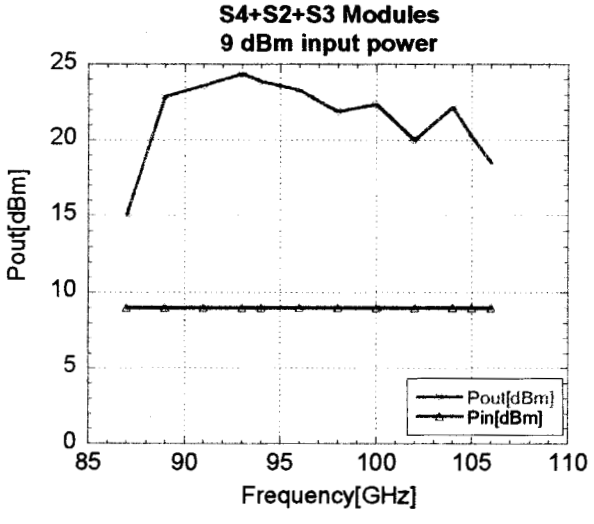

Figure 2.

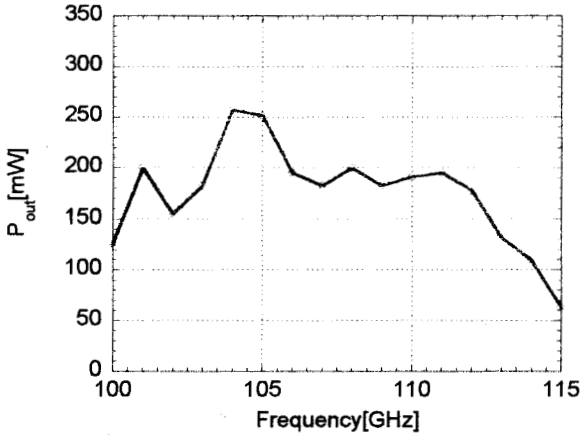

Figure3.